

## CLAIMS

1. A composition for polishing a substrate surface having at least one feature thereon comprising a noble metal, a noble metal alloy, a noble metal oxide, or any combination thereof, comprising:

periodic acid and an abrasive in a combined amount sufficient to render the substrate surface substantially planar upon chemical-mechanical polishing thereof.

2. The composition of claim 1, wherein periodic acid is in an amount from about 0.05 to about 0.3 moles/kilogram.

3. The composition of claim 1, wherein periodic acid is in an amount from about 0.075 to about 0.175 moles/kilogram.

4. The composition of claim 1, wherein the abrasive is in an amount from about 0.2 to about 6 weight percent.

5. The composition of claim 1, wherein the abrasive is in an amount from about 0.2 to about 4 weight percent.

6. The composition of claim 1, further comprising a pH-adjusting agent selected from a group consisting of a quaternary amine, an inorganic base, or any combination thereof.

7. The composition of claim 6, wherein the pH-adjusting agent comprises tetramethylammonium.

8. The composition of claim 6, wherein the pH-adjusting agent is selected from a group consisting of ammonium hydroxide, potassium hydroxide, sodium hydroxide, or any combination thereof.

9. The composition of claim 1, further comprising a pH-adjusting agent in an amount sufficient for a pH level of the composition to be in a range of from about pH 5 to about **pH 10**.

10. The composition of claim 1, further comprising a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 1 to about pH 4.

11. The composition of claim 1, further comprising a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 2 to about pH 3.

12. The composition of claim 1, further comprising a suspension agent.

13. The composition of claim 12, wherein the suspension agent is selected from a group consisting of an organic acid, a surfactant, another abrasive, and ethyl carbonate.

14. **The composition of claim 1, wherein the abrasive comprises an abrasive having a Mohs hardness number of greater than about 6.5.**

15. **The composition of claim 1, wherein the abrasive is selected from a group consisting of alumina, silica, zirconia, spinels, zirconium nitride, carbide, and any combination thereof.**

16. The composition of any of claims 1 through 12, wherein the abrasive comprises alumina.

17. The composition of any of claims 1 through 12, wherein the feature comprises a material selected from a group consisting of Ir, IrO<sub>2</sub>, Pt, and any combination thereof.

**18. The composition of claim 1, wherein said combined amount is sufficient to provide the substrate surface at a WWNU of less than about 12%.**

**19. The composition of claim 1, wherein said combined amount is sufficient to provide the substrate surface at a WTWNU of less than about 5%.**

20. A composition for polishing a substrate surface having at least one feature thereon comprising a noble metal, a noble metal alloy, a noble metal oxide, or any combination thereof, comprising:

periodic acid in an amount from about 0.05 to about 0.3 moles/kilogram; and  
an abrasive in an amount from about 0.2 to about 6 weight percent.

21. The composition of claim 20, wherein the amount of periodic acid is from about 0.075 to about 0.175 moles/kilogram.

22. The composition of claim 20, wherein the amount of the abrasive is from about 0.2 to about 4 weight percent.

23. The composition of claim 20, further comprising a pH-adjusting agent selected from a group consisting of a quaternary amine, an inorganic base, or any combination thereof.

24. The composition of claim 23, wherein the pH-adjusting agent comprises tetramethylammonium.

25. The composition of claim 23, wherein the pH-adjusting agent is selected from a group consisting of ammonium hydroxide, potassium hydroxide, sodium hydroxide, or any combination thereof.

26. The composition of claim 20, further comprising a pH-adjusting agent in an amount sufficient for a pH level of the composition to be in a range of from about pH 5 to about pH 10.

27. The composition of claim 20, further comprising a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 1 to about pH 4.

28. The composition of claim 20, further comprising a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 2 to about pH 3.

29. The composition of claim 20, further comprising a suspension agent.

30. The composition of claim 29, wherein the suspension agent is selected from a group consisting of an organic acid, a surfactant, another abrasive, and ethyl carbonate.

31. The composition of claim 20, wherein the abrasive comprises an abrasive having a Mohs hardness number of greater than about 6.5.

32. The composition of claim 20, wherein the abrasive is selected from a group consisting of alumina, silica, zirconia, spinels, zirconium nitride, carbide, and any combination thereof.

33. The composition of any of claims 20 through 29, wherein the abrasive comprises alumina.

34. The composition of any of claims 20 through 29, wherein the feature comprises a material selected from a group consisting of Ir, IrO<sub>2</sub>, Pt, and any combination thereof.

35. The composition of claim 20, wherein said composition is sufficient to render the substrate surface substantially planar upon chemical-mechanical polishing thereof.

36. The composition of claim 20, wherein said composition is sufficient to provide the substrate surface at a WWNU of less than about 12% upon chemical-mechanical polishing thereof.

37. The composition of claim 20, wherein said composition is sufficient to provide the substrate surface at a WTWNU of less than about 5% upon chemical-mechanical polishing thereof.

38. A method of polishing a substrate surface having at least one feature thereon comprising a noble metal, a noble metal alloy, a noble metal oxide, or any combination thereof, comprising:

providing a composition, the composition comprising periodic acid and an abrasive in a combined amount sufficient to render the substrate surface substantially planar upon chemical-mechanical polishing thereof; and

chemical-mechanical polishing the substrate surface with the composition.

39. The method of claim 38, wherein periodic acid is in an amount from about 0.05 to about 0.3 moles/kilogram.

40. The method of claim 38, wherein periodic acid is in an amount from about 0.075 to about 0.175 moles/kilogram.

41. The method of claim 38, wherein the abrasive is in an amount from about 0.2 to about 6 weight percent.

42. The method of claim 38, wherein the abrasive is in an amount from about 0.2 to about 4 weight percent.

43. The method of claim 38, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent selected from a group consisting of a quaternary amine, an inorganic base, or any combination thereof.

44. The method of claim 43, wherein the pH-adjusting comprises tetramethylammonium.

45. The method of claim 43, wherein the pH-adjusting agent is selected from a group consisting of ammonium hydroxide, potassium hydroxide, sodium hydroxide, or any combination thereof.

46. The method of claim 38, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH level of the composition to be in a range of from about pH 5 to about pH 10.

47. The method of claim 38, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 1 to about pH 4.

48. The method of claim 38, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 2 to about pH 3.

49. The method of claim 38, wherein said providing comprises providing a composition that further comprises a suspension agent.

50. The method of claim 49, wherein the suspension agent is selected from a group consisting of an organic acid, a surfactant, another abrasive, and ethyl carbonate.

51. The method of claim 38, wherein the abrasive comprises an abrasive having a Mohs hardness number of greater than about 6.5.

52. The method of claim 38, wherein the abrasive is selected from a group consisting of alumina, silica, zirconia, spinels, zirconium nitride, carbide, and any combination thereof.

53. The method of any of claims 38 through 49, wherein the abrasive comprises alumina.

54. The method of any of claims 38 through 49, wherein the feature comprises a material selected from a group consisting of Ir, IrO<sub>2</sub>, Pt, and any combination thereof.

55. The method of claim 38, wherein said chemical-mechanical polishing is sufficient to render the substrate surface substantially planar.

56. The method of claim 38, wherein said chemical-mechanical polishing is sufficient to provide the substrate surface at a WWNU of less than about 12%.

57. The method of claim 38, wherein said chemical-mechanical polishing is sufficient to provide the substrate surface at a WTWNU of less than about 5%.

58. A method of polishing a substrate surface having at least one feature thereon comprising a noble metal, a noble metal alloy, a noble metal oxide, or any combination thereof, comprising:

providing a composition, the composition comprising periodic acid is in an amount from about 0.05 to about 0.3 moles/kilogram and an abrasive in an amount from about 0.2 to about 6 weight percent; and

chemical-mechanical polishing the substrate surface with the composition.

59. The method of claim 58, wherein the amount of periodic acid is from about 0.075 to about 0.175 moles/kilogram.

60. The method of claim 58, wherein the amount of abrasive is from about 0.2 to about 4 weight percent.

61. The method of claim 58, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent selected from a group consisting of a quaternary amine, an inorganic base, or any combination thereof.

62. The method of claim 61, wherein the pH-adjusting agent comprises tetramethylammonium.

63. The method of claim 61, wherein the pH-adjusting agent is selected from a group consisting of ammonium hydroxide, potassium hydroxide, sodium hydroxide, or any combination thereof.

64. The method of claim 58, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH level of the composition to be in a range of from about pH 5 to about pH 10.

65. The method of claim 58, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 1 to about pH 4.

66. The method of claim 58, wherein said providing comprises providing a composition that further comprises a pH-adjusting agent in an amount sufficient for a pH-level of the composition to be in a range from about pH 2 to about pH 3.

67. The method of claim 58, wherein said providing comprises providing a composition that further comprises a suspension agent.

68. The method of claim 67, wherein the suspension agent is selected from a group consisting of an organic acid, a surfactant, another abrasive, and ethyl carbonate.



69. The method of claim 58, wherein the abrasive comprises an abrasive having a Mohs hardness number of greater than about 6.5.

70. The method of claim 58, wherein the abrasive is selected from a group consisting of alumina, silica, zirconia, spinels, zirconium nitride, carbide, and any combination thereof.

71. The method of any of claims 58 through 67, wherein the abrasive comprises alumina.

72. The method of any of claims 58 through 67, wherein the feature comprises a material selected from a group consisting of Ir, IrO<sub>2</sub>, Pt, and any combination thereof.

73. The method of claim 58, wherein said chemical-mechanical polishing is sufficient to render the substrate surface substantially planar.

74. The method of claim 58, wherein said chemical-mechanical polishing is sufficient to provide the substrate surface at a WWNU of less than about 12%.

75. The method of claim 58, wherein said chemical-mechanical polishing is sufficient to provide the substrate surface at a WTWNU of less than about 5%.

76. A substrate having a surface with at least one feature thereon comprising a noble metal, a noble metal alloy, a noble metal oxide, or any combination thereof, said substrate produced by the method of any one of claims 38 and 58.

77. The substrate of claim 76, wherein the surface thereof is substantially planar.

78. The substrate of claim 76, wherein the substrate surface has a WWNU of less than about 12%.

79. The substate of claim 76, wherein the surface thereof has a WTWNU of less than about 5%.